

BUILDING OCCUPANT LOCATION AND FIRE DETECTION SYSTEM

BACKGROUND OF THE INVENTION

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The invention relates to safety and security devices and methods and particularly to apparatus and methods for locating individuals in a building during an emergency. One such emergency situation may occur during a fire.

10 Establishing the location of individuals within a building during a fire is critical to individuals that may be trapped in the building as well as to individuals seeking to rescue them. Many firefighters have died attempting to rescue individuals that have been reported might be in a building. It is particularly sad when a firefighter dies seeking to rescue an individual that is

15 subsequently determined to have been in no danger.

United States Patent 6,587,049 issued to Thacker on July 1, 2003 states that several methods are known for manually signaling the wish not to be disturbed or the need for assistance by a person present in a given space as

20 representatively disclosed by Winston (see, U.S. Pat. No. 3,964,058), Perka, et al. (see, U.S. Pat. No. 6,104,942) and Wagner, et al. (see, U.S. Pat. No. 6,236,303). However, these methods are limited by the possibility that the person present in the space may be unable to perform the manual activity required to activate the desired signals or may neglect to do so.

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Various methods are also known for employing a single motion sensor to detect occupancy in a space as representatively disclosed by Kamada (see, U.S. Pat. No. 4,679,034), Myllymaki (see, U.S. Pat. No. 5,640,141), and Vories, et al. (see, U.S. Pat. No. 5,861,806). However, these methods cannot

30 reliably detect the presence of a person in a designated space since they may be activated by motion outside the designated space or by motion within the space that is caused by a source other than a person. Moreover, these methods cannot determine occupant status since they consider only one

disclosed by Adolf, et al. (see, U.S. Pat. No. 5,785,347), Corrado, et al. (see, U.S. Pat. No. 6,026,340), and Breed, et al. (see, U.S. Pat. No. 6,081,757). However, these methods do not determine multiple passenger conditions or employ indicators to signal information about the passenger's status. Rather, 5 they gather passenger data solely to confirm the presence of parameters related to deploying an airbag in a crash.

Relatively little attention has been focused on this problem despite substantial advances in the related technologies.

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SUMMARY OF THE INVENTION

It is an object of the present invention to provide an additional measure of safety both for building occupants as well as emergency workers such as 15 firefighters.

More particularly, it is another object of the invention to provide rescue workers very specific information about the location of individuals within a building.

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It is now been found that these and other objects of the invention may be attained in a system and method for providing assistance to emergency personnel that includes apparatus for detecting the presence of personnel within a protected premises, apparatus for detecting an imminent threat 25 selected from the group consisting of a fire, seismological and terrorist events and apparatus, responsive to the means for detecting, for displaying the location of personnel within protected premises.

In some forms of the invention the system includes apparatus for storing the 30 location of personnel within a protected premises that may include nonvolatile memory and may be capable of storing such data for a plurality of time periods.

The apparatus for detecting an imminent threat may include an ionization-type

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The apparatus for detecting an imminent threat may include an ionization-type

detector or a photoelectric detector or temperature sensing and may utilize fuzzy logic or Boolean logic. The temperature sensing apparatus may utilize one or more thermistors. Some forms of the apparatus in accordance with the invention may include structure for determining the last known good position
5 information.

The apparatus for detecting the presence of personnel may include ultrasonic apparatus, microwave apparatus, infrared sensing or a combination of both passive infrared and microwave sensors.

10 The decision-making process in the apparatus may be achieved when a logic circuit or a microprocessor. The apparatus for displaying the location of personnel within protected premises may include a floor plan on which the locations are defined and may include wireless apparatus for remotely
15 displaying the location of personnel within protected premises.

A method for providing assistance to emergency personnel which includes detecting the presence of personnel within a protected premises, detecting an imminent threat selected from the group consisting of a fire, seismological and
20 terrorist events, displaying the location of personnel within protected premises when an imminent threat is detected, further including the step of storing the location of personnel within protected premises, wherein the step of storing the location of personnel is achieved with nonvolatile memory.

25 The method for providing assistance to emergency personnel includes the step of storing the location of personnel for personnel within a protected premises for each of a plurality of time periods. The method for providing assistance to emergency personnel includes providing apparatus that includes a providing one such apparatus selected from the group that
30 includes (a.) ionization-type detector, (b) a photoelectric detector, (c) fuzzy logic, (d) Boolean logic, (e) temperature sensing, (f) ultrasonic apparatus, (g) at least one thermistor, (h) microwave apparatus and (i) infrared sensing.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be better understood by reference the accompanying drawing illustrating schematically the system in accordance with one form of 5 the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the figure, there is shown a system and method in 10 accordance with one form of the present invention. The building on which the system is installed includes a presence detection and historical data storage system 12 that is coupled to a fire/smoke detection system 14.

Known intrusion detection systems are inherently presence detection systems. 15 For the present application it is preferable that the intrusion system include memory and storage apparatus for retaining some historical data regarding activity over a period of time. Thus, such intrusion apparatus is capable of utilizing historical information if real time information is not available. Examples of intrusion detection systems include those shown in the following 20 United States patents having the same assignee as the present application:

6,593,850	Wireless intrusion detector with test mode issued on July 15, 2003 to Addy.
6,188,318	Dual-technology intrusion detector with pet immunity issued on February 13, 2001 to Katz, et al.
4,939,359	Intrusion Detection System with Zone Location issued on July 3, 1990 to Freeman.
4,614,938	Dual channel pyroelectric intrusion detector issued on September 30, 1986 to Weitman.
4,360,905	Intrusion Alarm System for Use with Two-Wire-Cable issued on November 23, 1982 to Hackett.
RE30,288	Intrusion Detection System issued on May 27, 1980 to Hackett.
4,035,798	Ultrasonic Intrusion Detection System issued on July 12, 1977 to

	Hackett.
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5 Examples of such a fire/smoke detection system 14 include the apparatus shown in the following United States patents having the same assignee as the present application:

6,150,935	Fire Alarm System With Discrimination Between Smoke And Non-Smoke Phenomena issued on November 21, 2000 to Anderson;
6,084,522	Temperature Sensing Wireless Smoke Detector issued on July 4, 2000 to Addy
5,781,291	Smoke Detectors Utilizing A Hydrophilic Substance issued on July 14, 1998 to So, et al.
5,764,142	Fire Alarm System With Smoke Particle Discrimination issued on June 9, 1998 to Anderson, et al.
5,726,633	Apparatus and Method for Discrimination of Fire Types issued on March 10, 1998 to Wiemeyer;
5,659,292	Apparatus Including a Fire Sensor and a Non-Fire Sensor issued on August 19, 1997 to Tice.
5,633,501	Combination Photoelectric and Ionization Smoke Detector issued on May 27, 1997 to Amieshi, et al.
5,557,262	Fire alarm System with Different Types of Sensors and Dynamic System Parameters issued on September 17, 1996 to Tice.
5,117,219	Smoke and Fire Detection System Communication issued on May 26, 1992 to Tice, et al.
4,916,432	Smoke and Fire Detection System Communication issued on May 26, 1992 to Tice, et al.
4,374,329	Smoke Detector with Test Apparatus issued on February 15, 1983 to Schoenfelder, et al.
4,316,184	Combination Combustion-Product Detector issued on February 16, 1982 to Nagel.
4,225,860	Sensitivity Controlled Dual Input Fire Detector issued on

	September 30, 1980 to Conforti.
4,097,851	Sensitivity Compensated Fire Detector issued on June 27, 1978 to Klein.
4,091,363	Self-contained Fire Detector with Interconnection Circuitry issued on May 23, 1978 to Siegel, et al.
4,020,479	Fire Detector issued on April 26, 1977 to Conforti, et al.

5 The disclosures of the above referred to patents are incorporated by reference. Various embodiments of the present invention may utilize different fire and smoke detecting apparatus as well as different intrusion detection and storage apparatus.

10 The output of the intrusion detection and historical data storage preferably includes data regarding the location of each person in each room (and in some cases in each part of very large rooms). Similarly, the fire detection system includes preferably sensing means for detecting the location of each fire or smoke in each room (and some cases in each parts of very large rooms). Ideally, the fire detection system includes apparatus for discrimination between various types of fires as described in United States 15 Patent 5,726, 633 (referred to above). That apparatus relies on the characteristics of the smoke to determine the type of fire producing smoke. As noted therein flaming fires exhibit quite different smoke characteristics than smoldering fires. As also noted therein the different types of smoke sensors respond differently depending on the fire type. Thus, photoelectric detectors 20 are known to respond more rapidly to smoldering fires than are ionization-type detectors. Similarly, ionization-type detectors are known to respond more rapidly to flaming type fires than do photo-electric detectors. The same patent describes fuzzy logic and Boolean logic techniques for analysis of such data. As described in United States patent 6,084,522 (referred to above) 25 temperature sensing in combination with a smoke detector is also useful. For example various embodiments may include a photoelectric sensor for determining the presence of smoke and a plurality of thermistors for providing a temperature signal reflective of a temperature level. Such detailed

information is particularly desirable for an ideal fire occupancy system.

It is desirable that the historical data storage portion of the apparatus maintain
5 location information over a period of time. This is significant because the
apparatus sensing the location of personnel information may at some point
been damaged so that no new location of personnel information will be
produced. In such a situation it is important that the system can rely on the
last known good information to produce the most accurate possible data to
10 fire department personnel. The ideal fire occupancy system is also provided
with detailed information from an intrusion detection system. Systems
including ultrasonic apparatus are disclosed in United States Patent
4,035,798 (referred to above) and Re 30,288 (referred to above). The latter
patent also describes microwave intrusion detection systems. United States
15 Patent 6,188,318 (referred to above) describes intrusion detection apparatus
and includes a passive infra red (PIR) sensor and a microwave sensor with
processing apparatus to detect a human intruder and reject other noise
producing sources. The processing is accomplished with a microprocessor.

20 The choice of circuitry for the logical step of concluding that a fire hazard
condition exists and then displaying the occupants location is not critical. In
one form of the invention the logic circuit performs a logical AND function.
Thus, if both an intrusion and a fire is indicated a display of the least the last
known good information is provided to fire department personnel. In other
25 embodiments any indication of fire automatically produces a display for fire
department personnel. In some cases the display will indicate that no one is
present in the protected premises. It is of course highly desirable to provide
this information for fire department personnel. Many fire department
personnel have been injured or killed searching for individuals that have been
30 falsely reported to be in a building. Thus, it is a vital concern that fire
personnel are provided with accurate information to avoid endangering fire
department personnel when no one is exposed to danger from the fire.
Similarly, it is a vital importance that fire department personnel know the
precise location of individuals within a protected premise.

The display of the location of personnel located within a protected premises is preferably available for fire department personnel and this is preferably accomplished by a wireless system. The display is also preferably communicated to a remote monitoring station or human personnel can observe evolving events. In some cases it may be desirable to transmit the location of personnel to "hardened" sites in the vicinity of the protected premises. In this context that term "hardened" is intended to refer to sites that are less vulnerable to a fire spreading throughout the protected premises.

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The wireless communication may be accomplished using various wireless techniques as described in United States patents 6,026,165; 6,167,137; 6,201,472; and 6,208,694 (referred to above). In addition the display may be transmitted utilizing Wi-Fi 802.11 technology to wirelessly transmit the information to physically spaced locations. This approach allows the use of standardized technology and insures that fire department personnel would have access at command posts at the protected premises or alternatively at each fire department apparatus located at the protected premises. Thus, even mobile fire engines, fire and police cars and other mobile apparatus may have a detailed display of the information. The same location information may also have application for other situations such as robberies, burglaries etc. Encryption measures may be employed to ensure that the information is not disclosed in a manner that would be prejudicial to the owner or manager of protected premises. Those skilled in the art will recognize that other systems for broadcasting such visual displays may also be utilized without departing from the spirit of the invention. For example, The Ademco Group of Honeywell International, Inc. manufactures graphic keypads that communicate with security panels. This combination allows a user at the graphic keyboard to selectively observe and/or listen to a plurality of zones within a protected premise. The display preferably includes a floor plan for a protected premises together, ideally, with the orientation thereof with respect to the North Pole as well as location of significant landmarks such as roads and the identification of such roads.

Although the description herein has referred to fire department personnel those skilled in the art will recognize that the apparatus in accordance with the present invention has application to other emergency situations. For example, other forms in the invention may include seismological monitoring equipment

5 either in combination with the above described apparatus or as a substitute for the fire detection apparatus. The seismological monitoring equipment may include conventional sensing devices known in the art. The prior art includes various automobile and building alarms that rely on impact and/or concussion to initiate an alarm. While the sensitivity of such systems is not directly

10 applicable for use with the present invention, those skilled in the art will recognize that the general type of sensors employed therein may be utilized to imitate the display of the occupants of a building. Such apparatus will have application in the event of earthquakes as well as acts of war or terrorism. For purposes of this application "seismological monitoring equipment" will be

15 understood to include equipment that can detect major acts of war as well as terrorism in addition to earthquakes and related phenomenon and "seismological events" includes earthquakes and earthquake related phenomenon as well as major acts of warfare and terrorism.

20 The respective methods and systems in accordance with the present system may utilize a computer that includes a microprocessor and memory and which cooperates with software that is commercially available or within the skill of practitioners in the programming arts.

25 It will be obvious to those having skill in the art that many changes may be made to the details of the above-described embodiments of this invention without departing from the underlying principles thereof. Accordingly, it will be appreciated that this invention is also applicable to other systems. The scope of this invention should, therefore, be determined only by the following claims.